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I, KIM MARSHALL, MANAGER EXAMINATION SUPPORT AND SALES, hereby certify that the annexed is a true copy of the Provisional specification in connection with Application No. PP 4710 for a patent by UNITED TECHNOLOGY PTY LTD filed on 16 July 1998.



WITNESS my hand this Sixth  
day of August 1999

KIM MARSHALL  
MANAGER EXAMINATION SUPPORT AND  
SALES

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**ORIGINAL**

**PROVISIONAL SPECIFICATION FOR AN INVENTION  
ENTITLED**

Invention Title: INTERNET UTILITY INTERCONNECT METHOD AND  
MEANS

Name of Applicant: UNITED TECHNOLOGY PTY LTD

Address for Service: COLLISON & CO. 117 King William Street,  
Adelaide, S.A. 5000

**The invention is described in the following statement:**

## Intranet Protocol.

Method for a virtual link interconnecting online database records to automation apparatus using a different type of message protocol.

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In one form of this invention it can be said to reside in a method in the one case and an apparatus in the other for interconnecting a master webserver to remote slave nodes using an appropriate protocol for control and automation over networks of different media including wire,  
10 radio, microwave and powerline.

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There can be effected therefore an arrangement that acts like a virtual internet link (VIL) which therefore responds to requests from the server and remotes to replicate information as though the remote node is connected to the Internet. The virtual link can be used for remote information reading as well as home automation and security reflected in the master server.

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Remote nodes can act on the internet database information through a master/slave/exception protocol supporting automation, metering, security, ecash transfers and Internet backchannel requests.

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In an embodiment a masterslave polling message establishes an event which is used to schedule any waiting exception message to be transmitted after a programmable time delay. There is a master and slave architecture for initiating reception of Internet requests from any node. Each node may be polled systematically, on a virtually continuous or periodic basis, by the server, which then replicates the data between the related database record and the addressed node. As a result of this arrangement the data transmission protocol establishes a virtual link to the internet for metering, information, automation, security, control and electronic commerce in the home or business. In addition the protocol allows messages to be forwarded to Internet service providers via the server.

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In a particular application energy consumption from a mains electrical power supply can be measured at the remote node and may therefore effect a deduction of ecash payments for subscribers according to authorised preprogrammed rates. A virtual Internet link allows for bi-

directional secure electronic payments so that the attached smartcard and e-cash devices can debit or credit approved payments. The automatic remote metering and control protocol is defined for communication between remote nodes (e.g. online database web server (e.g. Utility Gateway) which may communicate through data collection units supporting protocol conversion. A World Wide Web browser can monitor and control devices in homes and businesses via the utility server and slave nodes using the virtual link enabled by this described method and protocol.

### **Combined Transfer Media Functionality**

In a further form of this invention there is proposed a method for operating a remote control and monitoring system that replicates data between a host computer located at a central server site and a set of automation nodes located at a remote site.

In preference a replicating protocol provides a virtual link between the said remote site to said central website, and includes

- means to monitor said data such as utility meter readings'security, finance and Internet requests; and

means to link the data collected for subsequent access via the Internet

The protocol and apparatus in preference has a wireless communication capability. The system can in preference communicates with a central server over existing wire and wireless communication systems, such as local telephone, cellular phone, radio, powerline, landline, leased line, dial-up modem links and cable interfaces. The protocol may operate in a half-duplex mode over single transmission pair.

### **Local Electronic Billing and Payment**

In preference the system may provide a gateway to advanced consumer services at the remote location including prepayment systems. An energy billing system for charging the energy usage of an metered device in accordance with a downloaded authorised rate schedule from a webserver. Each predefined rate schedule can define different times periods and amounts of payment deductions directly from an e-cash The schedule of rates and periods form part of the VIL

protocol which also supports the transmission of the metered utility consumption.

### **Back Channel Web Browsing**

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- In preference there can be provided a service agent for fulfilling requests of a web browser client coupled to a local PC, Digital or Web TV set-top interface. This method of transmission of simplex internet requests, mainly URL (universal Resource Location) addresses is unique through exception messaging in combination with master/slave polling of automation and/or metering information to the server. The one way simplex operation provides a backchannel capability for utility providers to deliver interactive services for their subscribers. Security, local government and online information providers are regarded as utilities in addition to the traditional providers of water, gas, electricity and telephone services. Under this scheme each home has a equivalent IP address on the system and the remote node can send a request within the protocol.
- With this backchannel capability URL's are sent from the home to broadcast Internet providers supporting web browsing from TV cable and satellite downfeeds. A feature of the protocol is the reversal of the high integrity polled data which has low priority in response time combined with the low integrity Internet requests which gets the highest priority for speed of transmission. In this way the protocol can connect homes to the internet through URL requests from set top boxes to their broadcast TV service provider. The utility server can act as a half duplex server that is specifically designed to pass internet requests to broadcast systems. With very little additional overhead to automated metering a utility provider can forward subscriber Internet data requests to a broadcast service provider who can transmit Internet data to a browser running on a PC or TV with an Internet address.

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### **Internet Control**

- 35 In a further form ion preference there is provided a method of controlling devices attached to remote nodes provided through the Internet by the virtual linking of data records in the master web server. Under this arrangement each remote node has a virtual Internet address which is replicated from the server database. The web server can have the

- capability to be changed by authorised users though the Internet using a range of available commercial technologies. The database fields in the records (including security and air-conditioning controls) are dynamically linked to the remote nodes (automation interface node) by the VIL Protocol using a master/slave polling method with error checking to ensure integrity. This enables residents and other subscribers to turn on a range of connected devices in the home or work premises using the Internet.

## **10 Replication through sub-networks**

- Data concentrators may be of a type that use the same communication protocols as the remote nodes. This provides a means to route messages to a destination node through a second network and still maintain the virtual link between the server and the remote node. Data Concentrators are routers used to speed up communications in systems with many slaves. Each Data Concentrator replicates communication to a group of slaves through one communication port and acts as a large slave through the second port. The software then replicates the second port as if it were a large slave with increased speed.

- The Data Concentrator or Replicator can act as a Protocol Converter and communicate with the server using a higher speed communication channel using a variety of protocols yet maintaining the overall virtual Internet Link protocol between master server and slave node. The Data Concentrators can communicate with the slave devices using dial-up telephone, leased line, microwave, radio or satellite interfaces. Additional wide area or local area network interfaces can be used. A store and forward feature allows any Data Concentrator to relay a message to another when direct re-transmission is not possible. The data concentrator can be used to pass on or relay the message in both directions.

## **35 Exception Messaging**

- A further feature in preference in addition to the above is a method to support exception message transmission from the slave node when a request is initiated. When such a request is detected the slave unit

initiates a transmission to the Master unit and transfers that data. Timing is used to avoid potential collisions using the slave address to do this. Before any unit transmits it must first detect if any other unit is transmitting. This is achieved by detecting the break in the polled transmission and if another exception transmission is detected it delays until the end of the next polled transmission before it tries again. When multiple slaves require transmission at the same time an avalanche effect can result causing erratic system operation and sometime system failure. To cope with this a fall back process is used so that if after all possible attempts send the message caused by the exceptions have failed, each slave stops trying to transmit and waits until polled by the master.

### Field of the Invention

This invention relates generally to prepayment metering systems using the Internet and more particularly to a monitoring and control system for reading the measurement of commodities and security status switches at remote terminal points along a utility transmission network, which includes phone7 power and internet for control and transfer of electronic funds.

In a further form of this invention this can be said to reside in a method for bringing a residence into communication with a Internet server, so as to establish a home automation system, which is capable of electronic funds transfer as well as control and monitoring of attached peripherals.

An automation interface node apparatus can also provided for facilitating communication between the residence, and the webserver as a whole. The automation interface node may be capable of controlling, upon command, the specific detailed operations of the residence to which it is attached, and may, upon inquiry, transmit data which has been recorded, stored and/or calculated by the module.

The aforementioned advantages are provided by the present invention which provides a remote automatic meter reading, control and alert system, for reading the measurement of a commodity, controlling loads at a consumer or customer residence, and providing predetermined customer alert signals over a network of power lines.

A Utility Gateway Server, includes a computer which is connected to the Internet and the remote nodes through a data concentrator multiplexer unit for generation of commands and the receipt of data over communication lines. The commands generated by the server contain an address portion and a command message portion.

There is a automation interface node located at each customer residence. Each automation interface node is capable of selectively communicating with a plurality of utility meters and attached devices, for selectively driving a plurality of devices at a customer residence, for monitoring the status of a plurality of external contacts, and for selectively providing a plurality of alarms and messages to the customer. Each node includes a receiver for receiving commands from the server over a plurality of communication lines as well as a transmitter for transmitting return messages to the server over the same communication line. In order to increase the through-put capability, the protocol allows priority to requests for Internet addresses over commands for meter reading and security transfers.

It is therefore an overall object of the present invention to provide a remote automatic meter reading, control and security system as a background activity.

It is another object of the present invention to provide an automatic utility payment system, with encrypted security, for payment of the measured reading of a consumed commodity using a range of electronic commerce methods accepted by the consumer and the utility.

A still further object of the present invention is to provide a remote automatic meter reading, control and customer alert system incorporating controls for improving the energy management of utility services by customer usage and exception reporting, as well as assuring that loads which have been authorised to be turned off by the system will once again be turned on.

It is yet another object of the present invention to provide an master/slave command and message interlaced with customer event



requests whereby the data throughput for Internet requests is enhanced.

5 Still a further object of the present invention is to provide an meter reading, control and security system incorporating polled message formats in order to provide high integrity of customer billing information, security system operation and electronic funds transfer to the server database.

10 These and other objects of the present invention will become apparent from the following more detailed description of an example of use.

### Embodiment

15 The application is a protocol for home automation using powerline, wire and wireless media.

Among other benefits it enables water, gas and electricity prepayment and billing from smartcard terminals in the home.

20 Under this scheme each home has a TCP/IP address on a server database with utility fields (including security and air-conditioning controls) dynamically linked to the home embedded controller (automation interface node) using a master/slave polling and Internet URL exception driven protocol. With this backchannel URL's are sent from the home for supporting broadcast Internet web browsing from TV and satellite downfeeds.

30 This application hereinafter referred to as UuiP protocol would run on a range of hardware including an Automation Interface UAI in the home where it can connect to lighting, environment and entertainment networks. Ecash can be transferred in both directions and the protocol is suitable for industrial telemetry applications.

35 The Home Management System includes utility billing and control via Digital TV and the Internet. Each home has a TCP/IP address like a street address. Most utilities have expressed a desire to move to electronic pre-payment systems and the UUiP will be able to facilitate

this through smartcard and other electronic commerce payment systems.

- 5 One unique feature of UUiP is the reversal of the high integrity polled data has low priority in transfer time with the low integrity URL exception message getting the highest priority data transfer speed.

10 This extends the range of possibilities and benefits to Utilities and Home Owners. For example in today's deregulated power supply environment the benefit to the Utility of monitoring "by the minute" usage to assist with load profiling. And to both the Utility and the Home Owner of the use of SmartCards in the home to prepay utility usage with resulting better cash flow for the Utility and better use of money for the Home Owner.

15 The Utility Automation Interface UAI is a hardware apparatus which will operate, manage and measure a variety of everyday household functions by the UUiP message transfer to a community server for TCP/IP addresses for each connected household.

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#### *Basic Protocol Functionality*

25 The UuiP protocol is a low-speed polling network with exception URL's transmitted in between polled message (master-slave) transfers UuiP can support all the basic system requirements of the home management system including:

- Interface to a computer, and Digital Web TV, etc. is provided through TCP/IP Internet URL addressing from the home only
- 30 • Provision for central control of devices is via the UAI through the internet, a PC or Digital TV for display

35 The UUiP as proposed has a secure polling protocol with allowance for exception URL backchannel operating through a number of mediums including telephone, mains power and radio.

The protocol includes security and authorised access to standards accepted for electronic commerce.

The UUiP protocol is an efficient communications scheme to provide a virtual link to connect a record in the server database to a number of services in the home.

- 5 Embedded controller technology in the automation interface provides an in-home local area network (LAN) that can control home appliances and services that implement multiple protocols in addition to the virtual link to the Utility gateway server.

- 10 Each household can use a set-top box or PC as a terminal for interfacing the automation interface with major home appliances and consumers.

- 15 The protocol allows for a two-way transactional network offering small ecash financial transfers, home automation, energy management and an internet backchannel service. The electronic commerce capability will support portable components such as access and smartcards using card leaders, pin keypads and/or a TV or PC terminal interface .

- 20 **Utility consumption measurement (water, gas and electricity)**

The Automation Interface (UAI) is useful to delivering the potential of consumption measurement and billing, assistance with load profiling, and new payment and cash methods such as Smartcards.

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A small UAI panel designed for the home will provide a single point of access to phon. water, gas, electricity, internet and security services monitoring.

- 30 The UAI will handle output pulses from electricity, water and gas as protected inputs.

The UAI interfaces to water, gas and electricity meters which provide a contact closure option for detection of energy use.

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**Zoned theft and fire security systems**

A range of security controllers for 2 or more zones in the home providing independent control of theft and fire security are linked to remote monitoring services through the UAI.

## 5 Features

The UUiP is a two-way communications system that helps utilities manage their entire power distribution networks. It performs automatic and real-time accounting of individual energy consumption, enabling the utility to read meters remotely, generate invoices automatically, forecast costs and revenues accurately, and keep day-by-day balance sheets to support prepayment options.

UuiP protocol supports the following features:

15 Reduce overall management costs by giving the utility remote control of the system from a central point with comprehensive energy management.

20 • Advanced reliable Automatic Meter Reading

Over 400 consumers handled from one centralised point.

• Electronic payment and billing.

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Remotely reading meters and controlling customer loads.

Detailed reporting on electrical profile of each customer.

30 • Customer Information Services

• Supports various prepayment methods and schemes.

Inherent demand management.

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Increases customer involvement.

Provide new features such as daily energy accounting, load control, remote connect/disconnect, and home automation interface including security systems and smoke alarms

- 5 Prevent loss of revenue by remote detection of tampering and remote monitoring of losses

Increase operational efficiency by integrating various services (electricity, water, and gas metering) into one system

10

Detect and locate outages

### **Transport**

- 15 UuiP allows telemetry to function over radio, powerline, landline, leased line, dial-up modem links and cable interfaces such as RS232, RS422, RS485. Via external converters it is also possible to link units via fibre optic.

### **20 SCADA**

- 25 UuiP can be used for SCADA (Supervisory control and data acquisition) systems where SCADA refers to the combination of the herds of telemetry and data acquisition encompassing the collection of the information, transferring it back to a central site, carrying out any necessary analysis and control and then displaying this data on a number of operator screens. SCADA protocols using UuiP has support for

### **30 Master/Slave (Polled) Systems**

- 35 The server as master makes regular, repeated requests for data to each slave (UAI) in sequence, writing the data to each unit and reading that unit's data back in response. This is a half duplex protocol where the slave only responds to a request from the master. Each slave unit has a unique address or identification number based on IP sub addresses to allow this to function correctly. If the slave does not respond within a defined time, the master will retry again (up to a configurable number of retries) and then carries on polling the other units in the system. It is

possible to retry that unit again on several more re-transmissions before marking it as failed link after which the master will only poll it once each poll period to enable a restored link to be detected.

The advantages of this type of system are:

- 5           The process of data gathering is simple and easy to follow
- A link failure of a slave unit is detected fairly quickly
- No collisions can occur on the communications network, hence
- the data
- throughput is predictable and constant
- 10          For heavily loaded systems with each slave having constant data
- transfer
- requirements this gives a predictable and efficient system

### **Report By Exception (RBE)**

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To overcome some of the following disadvantages in polled systems UUIP can use submaster networks so that there are several small, fast messages which can be received by the server master in between polled messages.

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- Normally the interrupt type requests from a slave requesting urgent action cannot be handled within master/slave protocols.

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- Systems which are lightly loaded with minimum data changes from a slave are quite inefficient and unnecessarily slow

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UuiP supports Report By Exception as the slave station monitors its own inputs for a request for Internet data. When such a request is detected the slave unit initiates a transmission to the Master unit and transfers that data. Timing is used to avoid potential collisions using the slave IP sub address to do this. Before any unit transmits it must first detect if any other unit is transmitting. This can be done by detecting the break in the polled transmission and another exception transmission is detected transmission a delay is required until the end of the next

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polled transmission before it tries again.

When multiple slaves require transmission at the same time an avalanche effect can result causing erratic system operation and sometime system failure. To cope with this a fallback process is used so

that if after all possible attempts send the message caused by the exceptions have failed, each slave stops trying to transmit and waits until polled by the master.

5 The advantages of this are:

- It reduces the unnecessary transfer of data at any particular time as in polled systems.
- 10 • URL requests are detected quickly.

#### Internet Access

15 **Internet addresses** are assigned to slave nodes on the Internet server which is the master for the network. Each host gateway server must have its own Internet address and support sub-addresses for each slave node. A database is normally used for Address Resolution and storage of information exchanged with each slave. It should also translate Internet addresses to Ethernet addresses when needed with

20 LANS and WANS.

UUiP protocol runs over a variety of network media: IEEE 802.3 (ethernet) and 802.5 (token ring) LAN's, X.25 lines, satellite links, and serial lines. There are standard encapsulations for UUiP packets

25 defined for many of these networks, but there is no standard for serial lines. Serial Line UUiP, is used for master/slave serial connections using wire and wireless media.

30 UUiP defines a sequence of characters that frame data packets on a serial line. It provides addressing, packet type identification, error detection/correction and compression mechanisms.

UUiP is used for automation applications. It supports URL requests from set top boxes to connect homes to the internet through their

35 broadcast TV service provider. The utility server can act as a half duplex server that is specifically designed to pass internet requests to broadcast systems. With very little additional overhead an utility server can forward customer data requests to a broadcast service provider

who can transmit internet data to a browser running on a PC or TV with an Internet address.

### **Automated Meter Reading**

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A de-regulated energy market brings forth the critical need for Time Of Use metering, Load Profiling, Billing and Demand/Load Management for single and national multi-site customers to facilitate decisions with respect to energy costs and payment.

10

UUiP is focused on providing reliable, productivity-enhancing service solutions over publicly shared networks with emphasis on electronic meter reading and utility prepayment systems.

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UuiP is designed for utilities to develop advanced automated solutions for streamlining the collection and distribution of automation and control data.

### **ABSTRACT:**

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A method and apparatus for interconnecting a master webserver to remote slave nodes using a protocol for control and automation over networks of different media including wire, radio, microwave and powerline. The Virtual Internet Link (VIL) responds to requests from the server and remotes to replicate information as though the remote node is connected to the Internet. The virtual link is used for remote information reading as well as home automation and security reflected in the master server. Remote nodes act on the Internet database information through a master/slave/exception protocol supporting automation, metering, security, ecash transfers and Internet backchannel requests.

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Dated this 16th day of July 1998

UNITED TECHNOLOGY PTY LTD  
by their Patent Attorneys  
COLLISON & CO